CV dated November 15th 2025 for

MATHIAS CASIULIS

SCIENTIST, TEACHER, CREATOR

Basic Information

Dr. Mathias Casiulis (they/them)

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Mathias-Casiulis

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https://github.com/mkasiulis

TheLutetiumProject (EN)

LeProjetLutetium (FR)

Education

Sorbonne Université
PhD in Physics (2016-2019)

Ecole Normale Supérieure (Paris)
ICFP Master's Program
Quantum Physics Major (2015-2016)
Graduated magna cum laude

ESPCI Paris
Class of 2012
Physics Valedictorian

Lycée Louis-le-Grand (Paris)
Preparatory Classes (2010-2012)
Physics and Chemistry majors

Accomplishments

Alexei Likhtman Poster Prize (2025)
APS Soft Matter Video Prize (2024)
APS Milton van Dyke Award (2019)
APS Milton van Dyke Award (2017)
Physics Valedictorian at ESPCI (2015)

Languages

Human languages

French *(native)*, **English** *(bilingual)*, **Spanish** *(intermediate)*, **Lithuanian** *(basic)*, ***Japanese*** *(basic)*

Computer languages

Rust *(preferred)*,
Python, **C/C++**, **Wolfram language** *(proficient)*
Fortran, **Matlab, Julia** (notions)

Research

Senior Research Scientist - Understanding and harnessing disorder
Center for Soft Matter Research, New York University | 2022 - Present
Principal investigator: S. Martiniani
Career break: Parental leave (March 2023 - June 2023)

PostDoc - Non-equilibrium statistical mechanics of self-propulsion
Technion - Israel Institute of Technology, Haifa | 2020 - 2022
Principal investigator: D. Levine

PhD - Collective Motion without activity
LPTMC Lab, Sorbonne Université Paris | 2016 - 2019
Supervisors: M. Tarzia, L. F. Cugliandolo, O. Dauchot

Selected Publications (‡ indicates equal contribution)

- A. H. Shih‡, **M. Casiulis‡**, S. Martiniani,
  Fast Generation of Spectrally-Shaped Disorder,
  Physical Review E 110 (3), 034122 (2024),
  Featured in Physics, Editor's Suggestion, Award-Winning
- ***M. Casiulis*** *et al.,*
  A geometric condition for robot-swarm cohesion and cluster-flock transition,
  PNAS 122 (37), e2502211122 (2025)
- **M. Casiulis‡**, A. H. Shih‡, S. Martiniani,
  Gyromorphs: a new class of disordered functional materials,
  Physical Review Letters 135 (19), 196101 (2025),
  Editor's Suggestion
- P. Suryadevara‡, **M. Casiulis‡**, S. Martiniani,
  The Basins of Attraction of Soft Sphere Packings Are Not Fractal,
  ArXiv:2409.12113 (2024) [In review at PRL]

Mentoring

Directly mentored 2 high school student and 3 undergraduates at NYU.
Co-mentoring 2 graduate students at NYU.

Teaching

Coordinator of "Physics for All" - Ecole Normale Supérieure (2016-2019)
Teaching Assistant - Sorbonne Université (2016-2019)
Teaching Assistant - Lycée Louis-le-Grand (2012-2014)

Outreach

Co-founder and Vice-president of The Lutetium Project (2014-2021)

22,000 subscribers across 2 languages | 800,000 views
Producer, scriptwriter, and occasional host for an outreach YouTube channel focused on soft matter physics and optics.

Complete List of Publications (‡ indicates equal contribution)

- L. V. Luzzato, **M. Casiulis**, S. Martiniani, I. A. Kovács.
  Spatial and Temporal Cluster Tomography of Active Matter
  ArXiv:2511.09444 (2025) [In review at PRL]
- ***M. Casiulis‡**, A. H. Shih‡, S. Martiniani,*
  Gyromorphs: a new class of functional disordered materials,
  Physical Review Letters 135 (19), 196101 (2025). **Editor's Suggestion**
- P. Suryadevara‡**, M. Casiulis‡**, S. Martiniani,
  The Basins of Attraction of Soft Sphere Packings Are Not Fractal,
  ArXiv:2409.12113 (2024) [In review at PRL]
- ***M. Casiulis,** E. Arbel, Y. Lahini, S. Martiniani, N. Oppenheimer, M. Yah Ben Zion,*
  A geometric condition for robot-swarm cohesion and cluster-flock transition,
  PNAS 122 (37), e2502211122 (2025) (2025)
- A. H. Shih‡, **M. Casiulis‡**, S. Martiniani,
  Fast Generation of Spectrally-Shaped Disorder,
  Physical Review E, 110 (3), 034122 (2024). ***Featured in Physics, Editor's Suggestion***
- C. Anzivino‡, **M. Casiulis‡**, T. Zhang, S. Martiniani, A. S. Moussa, A. Zaccone,
  Estimating RCP as the densest isostatic packing in polydisperse hard spheres,
  Journal of Chemical Physics 158, 044901 (2023)
- **M. Casiulis**, S. Martiniani,
  When you can't count, sample! Computable entropies beyond equilibrium from basin volumes,
  Papers in Physics 15, 150001 (2023)
- **M. Casiulis**, D. Levine,
  Emergent Synchronization and Flocking in Purely Repulsive Self-Navigating Particles,
  Physical Review E, 106(4), 044611 (2022)
- **M. Casiulis**, D. Hexner, D. Levine,
  Self-propulsion and self-navigation: Activity is a precursor to jamming,
  Physical Review E 104, 064614 (2021)
- G. Durey, Q. Magdelaine, **M. Casiulis,** H. Kwon, J. Mazet, P. Chantelot, A. Gauthier, C. Clanet, D. Quéré,
  Droplets Impaling on a Cone,
  Physical Review Fluids 5, 110507 (2020)
- **M. Casiulis,** M. Tarzia, L. F. Cugliandolo, O. Dauchot,
  Velocity and Speed Correlations in Hamiltonian Flocks,
  Physical Review Letters 124, 198001 (2020)
- **M. Casiulis**, M. Tarzia, L. F. Cugliandolo, O. Dauchot,
  Order by disorder: saving collective motion from topological defects in a conservative model,
  Journal of Statistical Mechanics, 013209 (2020)
- **M. Casiulis**
  Study of a non-Galilean Hamiltonian liquid: collective motion without activity
  PhD Thesis, Sorbonne Université, NNT: 2019SORUS647, tel: 03347594
- **M. Casiulis**, M. Tarzia, L. F. Cugliandolo, O. Dauchot,
  Ferromagnetism-induced phase separation in a two-dimensional spin fluid
  Journal of Chemical Physics 150(15), 154501 (2019)
- G. Durey, H. Kwon, Q. Magdelaine, **M. Casiulis,** J. Mazet, L. Keiser, H. Bense, P. Colinet, J. Bico, E. Reyssat
  Marangoni bursting: Evaporation-induced emulsification of a two-component droplet,
  Physical Review Fluids 10, 100501 (2018)
- M. Dupont-Nivet, **M. Casiulis,** T. Laudat, C. I. Westbrook, S. Schwartz,
  Microwave-stimulated Raman adiabatic passage in a Bose-Einstein condensate on an atom chip,
  Physical Review A 91, 053420 (2015)

Patents

- ***M. Casiulis‡**, A. H. Shih‡, S. Martiniani, U.S. Provisional Patent Application No. 63/651,613 filed May 24, 2024 Entitled "SYSTEM, METHOD AND COMPUTER-ACCESSIBLE MEDIUM FOR ACCELERATED GENERATION OF STATISTICALLY CORRELATED POINT STRUCTURES"*

Grants and Funding

- ***Lutetium Project Funding,*** Various sources, about 15000 Euros | 2014-2020

Co-wrote and applied funding applications for the Lutetium Project, used to buy video equipment and pay artists working on the project as contractors. Main sources of funding were the Paris Sciences et Lettres student project calls (about 2000 Euros), the ESPCI Alumni Association funding calls (about 5000 Euros), and the ESPCI Fund project calls (remaining amount).

- **EDPIF Doctoral Fellowship,** EDPIF, PI: Marco Tarzia & Leticia F. Cugliandolo| 2016-2019

Theses in France are typically funded through Graduate Schools, that grant fellowships to students based on their research project after a selective written and oral examination. This fellowship consists in 3 years of salaries.

- **ESPCI Alumni Travel Grant,** 1000 Euros, PI: Olivier Dauchot | 2016

Secured travel compensation from the ESPCI Alumni Association to attend the Beg Rohu Summer School 2016 before my PhD started.

- **Air Force Office Of Scientific Research - Young Investigator Research Program,** PI: Stefano Martiniani | 2025

Co-wrote all stages of a funding application for about 450,000 USD with Pr. Stefano Martiniani.
FOA number: FOAAFRLAFOSR20240004

Awards and honors

- **Alexei Likhtman Poster Prize, 9th Edwards Symposium, University of Cambridge | 2025**
- **APS-DSOFT Gallery of Soft Matter, Video Prize | 2024**
- **APS-DFD Milton Van Dyke Award, First Prize | 2019**
- **APS-DFD Milton Van Dyke Award, First Prize | 2017**

The APS-DFD Milton Van Dyke Award is awarded to the best science video on current research. It recognizes excellence in four aspects: original research in fluid dynamics, scientific rigor, artistic qualities, and pedagogical endeavors. Videos by the Lutetium Project were awarded the first prize in two occasions. The APS-DSOFT recently launched a similar video prize.

Talks, Schools and Conferences (Research)

Bold locations indicate invited talks

- *"Understanding and harnessing disorder, from point patterns to materials", **LOMA Seminar**, Université de Bordeaux, November 13th 2025*
- *"Understanding and harnessing disorder, from point patterns to materials", **LIPhy Theory Seminar**, Université Grenoble-Alpes, November 4th 2025*
- *"Correlated Disorder as Metamaterials", 9th Edwards Symposium, Cambridge University, September 2025*
- *"Understanding and Harnessing Disorder Through Optimization", 4èmes Journées du GDR IDE, Sète,* September 2025
- *STATPHYS satellite: Classical and Quantum Complexity in Statistical Mechanics, Molveno, July 2025 - Poster*
- ***"Robotic Swarms can Pull their Weight to Cluster or Flock", Laboratoire Charles Coulomb Seminar**, University of Montpellier,* July 9th 2025
- *"Gyromorphs: a new class of functional disordered materials", APS Global Physics Summit 2025, Anaheim, March 19th 2025*
- ***"Painting in Fourier Space",* APS Global Physics Summit 2025 Invited Session**, Anaheim, March 17th 2025
- "Understanding and Harnessing Disorder", OIST Seminar, Onna, Okinawa, Japan, January 29th 2025
- **"Fast generation of spectrally shaped disorder", Hyperuniformity Workshop, INRIA**, Paris, December 11th-December 13th 2024
- "Spectral Optimization for Functional Materials", Simons Center for Computational Physical Chemistry Symposium, September 2024
- Center for Soft and Living Matter Opening Symposium, University of Pennsylvania, June 2024 - Poster
- "Shaping and Harnessing disorder in photonic materials", APS March Meeting 2024, Minneapolis, March 2024
- "Spectrally-Shaped Disorder for Materials Design and Integration", Berkeley Statistical Physics Meeting, Berkeley, January 2024
- *Les Houches Summer School 2023*: *Waves in Complex Media, From Theory to Practice* - Poster
- **"A coordination approach to Random Close-Packing", Simons Center for Computational Chemistry Seminar**, New York, May 8th, 2023
- Inaugural Symposium of the Simons Center for Computational Physical Chemistry, New York, October 7th, 2022 - Poster
- "A coordination approach to random close-packing", CSMR Monday meetings, September 26th, 2022
- "Volumes in high-dimensional landscapes" - NCS-17 meeting, Stevens Institute of Technology, Hoboken, June 24th, 2022
- **"Direct Measurements of configurational entropies" - Physics of Information Workshop**, NYU, New York, May 24th, 2022
- **"Self-navigating particles: escapes, jams, and sync" - Gulliver lab Active Matter Meeting**, Paris, December 9th, 2021
- **"Self-navigating particles: escapes, jams, and sync" - Physics Department Seminar, Technion**, Haifa, July 7th, 2021
- **"Collective Motion Without Activity" - Theoretical Physics Journal Club, Technion**, Haifa, January 26th, 2020
- **"Collective Motion Without Activity" - MSC lab Seminar**, Paris, December 5th, 2019
- **"Collective Motion Without Activity" - Gulliver lab Active Matter Meeting**, Paris, May 28th, 2019
- **"Collective Motion Without Activity" - Gov lab group seminar at the Weizmann Institute of Science**, Rehovot, January 29th, 2019
- **"Collective Motion without Activity" - Hayakawa group seminar at YITP**, Kyoto, December 21st, 2018
- **"Collective Motion without Activity" - Osaka Cybermedia Center Seminar**, Osaka, December 21st, 2018
- **"Collective Motion without Activity" - Simons Collaboration "Cracking the Glass Problem" seminar**, Paris, November 15th, 2018
- *Les Houches Summer School 2018: Active Matter and Non-Equilibrium Statistical Physics - Poster*
- *Journées de Physique Statistique 2018 (January 25th and 26th, 2018, ESPCI Paris) - Short Talk: "Collective Motion In Equilibrium"*
- *Beg Rohu Summer School 2017: Out of equilibrium dynamics, evolution and genetics - Poster*
- *Beg Rohu Summer School 2016: Concepts and Methods of Statistical Physics - Poster*

Papers, Talks and Conferences (Outreach)

- "Active Particles Push the Boundaries of Two-Dimensional Solids", **Physics 16, 146**, 2023
- "How do I make this plot?? A few ideas on data visualization", **Courant MSG lunch meetings**, New York, April 27th, 2023
- "Different Minds Make Better Outreach" - **TEDx Talk** at the TEDxSorbonneU "Synergies of the Mind", Paris, October 18th 2019
- "The Lutetium Project", **IPGG Microscale Affairs Seminar**, Paris, January 9th, 2019
- YouTube Masterclass "#EllesFontYouTube | Elles Font la Culture", YouTube Space Paris, November 21st, 2018
- "La Méthode Scientifique - La 500ème" - **La Méthode Scientifique, sur France Culture**, November 16th, 2018
- "Table ronde des actualités des sciences et de la recherche" - **La Méthode Scientifique, sur France Culture**, May 25th, 2018
- "Le Projet Lutétium", **Soirée grand public des Troisièmes Rencontres Scientifiques des Grands Causses**, April 10th, 2018
- "Le Projet Lutétium : Recherche expérimentale, Création scientifique et Vulgarisation scientifique sur YouTube" - **Conférence grand public du Réseau de Jeunes de la Société Chimique de France section Bourgogne Franche-Comté**, Université de Bourgogne, March 30th, 2018
- "How to popularize science?" - **Round table for the Open Days in Biology, Computer Science and Mathematics (JOBIM)**, July 7th, 2017
- "La notion de collectif en art-science" - **Table ronde pour l'antenne parisienne du Festival Imagine Science**, June 3rd, 2017
- "Peut-on apprendre sur Internet en France ?" - **La Méthode Scientifique, sur France Culture**, December 9th, 2016
- "Table ronde des actualités des sciences et de la recherche" - **La Méthode Scientifique, sur France Culture**, 28 octobre 2016
- "Le Projet Lutétium", **La Tête au Carré, sur France Inter**, October 7th, 2016

Note for non-francophones:
La Méthode Scientifique was a daily broadcast on the national French radio "France Culture." It was an outreach broadcast that focused on recent advances in scientific research. La Tête au Carré was its counterpart on the more general national French radio "France Inter." Both were listened to by several tens of thousands of French speakers live, and podcasts had an audience roughly an order of magnitude larger.

Outreach videos (outside the Lutetium Project)

- *"Painting Correlations in Fourier Space"*, 2024 Winner of the APS DOST Gallery of Soft Matter, Featured in Physics.
  Contribution: Animation, edition, sound mixing, screenplay
- *"The intricate ballet of self-navigating particles: Flocks, synchronization, laning and defects", 2022 entry to the APS DSOFT Gallery of Soft Matter*
  Contribution: Animation, edition, sound mixing, screenplay
- *"Cuts of basins of attraction of soft spheres in high dimensions", 2022 entry to the APS DSOFT Gallery of Soft Matter*
  Contribution: Animation, edition, sound mixing, screenplay

Detailed education

- ***PhD in Physics,*** *LPTMC Lab, Sorbonne Université, Paris | 2016-2019*

I studied the behavior of a non-Galilean yet conservative Hamiltonian model of polar particles. Due to a coupling between the polar degree of freedom and the linear velocity, this system exhibits a rich phase behavior, comprising a phase separation, spontaneous collective motion, and magnetically frustrated phases that can all be captured within the framework of equilibrium statistical mechanics. The work was largely numerical, using Molecular Dynamics (MD) simulations, with some analytical elements to get mean-field level predictions.

- **Master's degree, Quantum Physics Major (magna cum laude)**, ICFP-ENS Program, ENS Paris | 2015-2016

Theory-oriented master's program, with a quantum coloration.

- **Master's degree, Physics Major (Physics class valedictorian)**, ESPCI Paris | 2012-2015

ESPCI Paris is a French *Grande École*, that teaches hands-on physics, chemistry and biology, with a strong emphasis on labs. The curriculum focuses on soft matter, and wave propagation in complex media. The degree is a French "Diplôme d'Ingénieur des Grandes Écoles".

- **Preparation to the *Grandes Écoles* competitive entrance exam,** Lycée Louis-le-Grand | 2010-2012

Prior to taking the competitive entrance exam to *Grandes Écoles*, French students undergo at least two years of preparation. Lycée Louis-le-Grand is the top such place nationwide in science.

Detailed teaching activity

- ***Lecturer for "Physics for All", 15h,*** Department of Physics, ENS Paris | 2016-2019

I wrote lecture notes, gave lectures, prepared exercises, graded, and wrote exams together with 3 other lecturers. The course, worth 3 European credits (ECTS), was an introduction to modern physics for students in humanities at ENS. My own lectures covered the applications of statistical physics to polymer physics, chemical physics, biophysics, and econophysics; as well as quantum states of matter.

- **TA for "Statistical Mechanics" (3rd year undergrad course), 64h,** Department of Physics, Sorbonne Université | 2019

I created new exercise sheets and gave exercise classes going from macroscopic thermodynamics to the foundation of statistical mechanics and some basics of stochastic dynamics. A large part of the sheets was renewed alongside Matthieu Micoulaut. I also co-wrote and graded homework as well as the exams.

- **TA for "Newtonian Mechanics" (1st year undergrad course), 128h**, Department of Physics, Sorbonne Université | 2016-2018

I taught exercise classes as well as lab classes in basic mechanics, going from Newton's laws to the response of driven harmonic oscillators. I also graded hundreds of exams for the course.

- **TA in Physics and Chemistry in *Classes Préparatoires* (1st and 2nd year undergrads), 150h,** Lycée Louis-le-Grand | 2012-2014

I taught weekly oral examinations on the whole of physics, from Newtonian mechanics and basic electricity to electromagnetics, optics, and hydrodynamics, in the structure that prepares students for the competitive entrance exams to *Grandes Écoles*. Exercise writing was completely at my own discretion, and so was the grading.

Detailed Mentoring

- ***Tom Zhang (now at Caltech),*** High School Project at NYU | 2022

Worked on symbolic regression for values of RCP against polydispersity. Co-author of one of my papers.

- **Milan Lustig (Cold Spring Harbor High School),** High School Project at NYU | 2023

Worked on implementing Nested Sampling in Rust for soft sphere potentials.

- **Runjia "Orion" Yang (Courant)**, AM-SURE Research Fellow at NYU | 2023

Worked on implementing Information-Theoretical entropy measurements based on sampling match lengths in simple cases alongside Carmel Pe'er, and on basic applications to neuroscience datasets.

- **Carmel Pe'er (Harvey Mudd College)**, AM-SURE Research Fellow at NYU | 2023

Worked on implementing Information-Theoretical entropy measurements based on sampling match lengths in simple cases alongside Runjia "Orion" Yang, and on basic applications to neuroscience datasets.

- **Nicholas Labranche**, NYU Undergraduate Project | 2023

Worked on assessing whether the disorder-order transition observed when making 2d Stealthy Hyperuniform Structures was also observed in 3d point patterns.

- **Praharsh Suryadevara**, NYU Graduate Student | 2022-Present

Worked on the study of the Potential Energy Landscape of soft repulsive spheres in the jammed regime. One paper is out, another in preparation.

- **Aaron H. Shih**, NYU Graduate Student | 2022-Present

Worked on the implementation of the Fast Reciprocal-Space Correlator (FReSCo), as well as its use to produce bandgap materials, leading up to the definition of gyromorphs. Two papers out, one in preparation.

Detailed Service Tasks

- ***Elected PhD Students representative,*** LPTMC | 2016-2019

Represented the voice and interests of PhD Students at Faculty Meetings during my PhD.

- **APS March Meeting 2025 Focus Session Organizer and Chair,** APS | 2024-2025

Proposed and organized the Focus Session "Long-Range Correlations in Disordered Matter", sponsored by the GSNP thematic group and co-sponsored by DSOFT. Selected and sorted abstracts, invited a speaker, chairing the session.

- **Peer Review for physics journals,** Various | 2018-Present

Reviewed over 20 papers for a variety of journals, notably Physical Review Letters, Physical Review E, The Journal of Chemical Physics, Soft Matter, and the Proceedings of the National Academy of Science of the United States.
Usual topics cover soft matter, statistical mechanics, and the theory of liquids.

Professional references - Research (Collaborators)

Preferred ones are placed in the left-most column

Pr. Leticia F. Cugliandolo

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Pr. Marco Tarzia

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Pr. Dov Levine

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Postdoctoral advisor
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Pr. Olivier Dauchot

Full Professor of Physics at CNRS/ESPCI Paris
PhD co-advisor, Master's Project advisor
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Pr. Stefano Martiniani

Assistant Professor of Physics and Chemistry at NYU
Postdoctoral advisor
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Pr. Paul Chaikin

Silver Professor of Physics at NYU
Collaborator
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Professional references - Research (External)

Preferred ones are placed in the left-most column

Pr. Jorge Kurchan

Professor of Physics at CNRS/ENS Paris
External reference, familiar with my work
E-Mail: jorge.kurchan@phys.ens.fr

Pr. Daan Frenkel

Professor of Chemistry at the University of Cambridge
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Professional references - Teaching

Preferred ones are placed in the left-most column

Pr. Matthieu Micoulaut

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Pr. Yannick Klein

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